Bridge at Mouth of Rogue River
(Isaac Lee Patterson Memorial Bridge)
Spanning Rogue River on the Oregon Coast Highway
Gold Beach
Curry County
Oregon

HAER OR-38

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HISTORIC AMERICAN ENGINEERING RECORD

BRIDGE AT THE MOUTH OF ROGUE RIVER (ISAAC LEE PATTERSON MEMORIAL BRIDGE) HAER OR-38

Location:	Spanning Rogue River on the Oregon Coast Highway, between Gold Beach and Wedderburn, Curry County, Oregon UTM: Gold Beach, Oregon Quad. 10/383840/4697930
Date of Construction:	1930-32
Structural Type:	Reinforced-concrete arch, built using Freyssinet method of arch centering
Engineer:	Conde B. McCullough, Oregon State Highway Department
Builder:	Mercer-Fraser Co., Eureka, California
Owner:	Oregon Department of Transportation
Use:	Vehicular and pedestrian bridge
Significance:	The Bridge at the Mouth of Rogue River is the first reinforced-concrete arch span built in the United States using the Freyssinet method of arch decentering. In this technique, arch ribs are pre-stressed by hydraulic jacks placed at their crowns to compensate for deformations due to shrinkage of concrete, differential temperature changes, movement of supports, and elastic and plastic shortening. The result is that, in theory, the ribs shorten to a point equal to, but not beyond, their original position. The Oregon State Highway Commission and the U.S. Bureau of Public Roads built this bridge to provide a modern crossing over the Rogue River and to conduct a sophisticated experiment in which they tested French bridge engineer Ernest Freyssinet's hypothesis. The two government agencies provided much insight into this technique for the engineering community through their sophisticated collection of data and reporting of their findings. In 1982 the bridge received the American Society of Civil Engineers' designation as a National Historic Civil Engineering Landmark because it made a contribution toward the development of the civil engineering profession in the United States.
Project Information:	Documentation of the Bridge at the Mouth of Rogue River is part of the Oregon Historic Bridge Recording Project, conducted during the summer of 1990 under the co-sponsorship of HABS/HAER and the Oregon Department of Transportation. Researched and written by Robert W. Hadlow, HAER Historian, 1990. Edited and transmitted by Lola Bennett, HAER Historian, 1992.
Related Documentation:	For more information on Conde B. McCullough, see HAER OR-54.

HISTORY

The ability to easily cross the mouth of the Rogue River, on Oregon's south coast, became an increasing concern for local citizens and tourists in the 1920s. By 1929, when the United States was sinking under the heavy load of its severest economic depression, state officials called for the construction of what was to be the largest Pacific Coast bridge between San Francisco, California and Seattle. Overnight it turned sleepy fishing villages into boom towns and changed forever the landscape and outlook.

The State of Oregon created its highway department in 1913 to inaugurate a new era of public road and bridge building. By 1916, the United States government began to finance part of the costs of construction through the Federal Aid Road Act of 1916. It aimed to coordinate state road construction projects on a national basis. At the end of the First World War, Oregon legislators rallied around the call for a "motor road" along the state's coastline as part of a stronger national defense system, directed toward preventing potential foreign invaders from landing on the west coast of the U.S.[1]

Oregon voters approved the sale of $2.5 million in bond obligation, in 1919, to match federal military highway funds to finance a shoreline route. Nevertheless, monies from Washington failed to materialize and state government authority to sell construction bonds eventually lapsed. By the early 1920s, a mobile pleasure-seeking public clamored for improved travelling between Portland and the ocean beaches, and for construction of a coastal highway. Work began, in 1921, on a new road designed by the state's highway department and funded by more traditional state and federal construction funds. The Roosevelt Coast Military Highway extended the length of Oregon's coast by the early 1930s. Yet, not all road surfaces were covered with asphalt or concrete pavement, making travel over the route a sometimes muddy affair. In addition, motorists still needed to make portages over two bays and four rivers.[2]

Ferries travelled between Gold Beach and Wedderburn almost since the founding of the villages in the nineteenth century. In the late 1920s, private citizens and chambers of commerce all along the Oregon coast complained bitterly about the slow unreliable ferry service at Gold Beach, Reedsport, Coos Bay, Florence, Alsea Bay and Yaquina Bay. One critic called the crossing at the mouth of the Rogue river an abomination. He wrote that the coast highway would "never amount to anything until there is a bridge built [at Gold Beach]." California vacationers, he believed, were by-passing the Oregon coast to take advantage of more complete routes to the east. As a result, the region's communities were deprived of tourist dollars that they deserved.[3]

The McMinnville (Oregon) Chamber of Commerce favored a plan in which the state reissued old construction bonds to finance completion of the Roosevelt Coast Military Highway. It included a proposal to erect a $600,000 bridge at Gold Beach. The civic organization believed that the only way Oregon's population could reap any benefits from the $11 million already spent on the coast highway was to begin replacing its antiquated ferry system with modern bridges.[4]

The State Highway Commission (OSHC), by June 1929, had studied various schemes for a proposed span at the mouth of the Rogue river. Of eight designs that met U.S. Bureau of Public Roads standards for bridges, it chose what appeared to be the most costly alternative, at an estimated $628,000. In reality, though, the structure would provide a wide road deck, ample sidewalks and require little expensive realignment of existing approaches. Alternatively, the least expensive design, $156,000 less than the one that the commission approved, would have spanned the river upstream and away from the proposed route for the coast highway. It appears that the commission also considered aesthetics and clearance for ship traffic in reaching it decision.[5]

In November 1929 the U.S. War Department's Army Corps of Engineers who oversaw construction of structures over navigable waters, granted the OSHC a permit to build a bridge at Gold Beach. The commission called for bids for a seven-span reinforced-concrete deck-arch structure at its December 1929 meeting. Its action attracted attention from many large construction companies. On January 16, 1930, the Mercer-Fraser Company of Eureka, California received the contract for $568,181.00.[6]

Congress pushed for construction to begin as soon as possible since the United States was facing severe economic problems in the wake of the stock market crash of the previous October. Federal contributions amounted to two-thirds of the cost of the bridge. Congressmen saw the project as an integral part of President Herbert Hoover's policy of speeding up government's response to accelerating nationwide unemployment through limited public works programs.[7]

The bridge neared completion in late 1931. By December 1, it carried its first vehicle, a truck hauling fill rock from the north end of the structure to the south. Originally, contractors hoped to open the span to general use sometime in January 1932, but an extremely wet December had swollen the Rogue River and disabled the old ferry, the Rogue. Private vehicles first crossed the bridge on Christmas Eve day. The ferry never ran again at Gold Beach, and its crew finally towed the vessel--in its dilapidated state--to Alsea Bay to provide supplemental service there.[8]

The contractor presented the bridge to OHSC on January 21, 1932. Motorists could travel on a combination of paved and graveled surfaces the length of the state, traversing minor streams by bridge. The projected popularity of the Oregon Coast Highway prompted many to speculate that the state would soon replace ferry service at Coos Bay, Reedsport, Florence, Newport and Waldport with structures similar to the bridge at Gold Beach.[9]

In April 1932, local citizens had begun plans for a one-day event to mark the completion of the Bridge at the Mouth of Rogue River and the Oregon Coast Highway. A celebration committee was organized, comprised of prominent businessmen, with Robert L. Withrow, editor of the Gold Beach newspaper, the Curry County Reporter, as its secretary. Correspondence between him and State Bridge Engineer, Conde B. McCullough reveals much about the sequence of events that led up to the May 28 ceremonies. Within the past year, the Oregon state legislature had approved a resolution to dedicate the Rogue River bridge to the late governor, Isaac Lee Patterson, who had spearheaded the campaign for the structure in 1929, to replace the ferry at Gold Beach. He died from pneumonia later that year. According to its policy, the OHSC preferred to name "larger bridges on state highways for prominent citizens or pioneers of [the] state." Patterson's nomination was completely acceptable with the commission's wishes.[10]

Initially, the planning committee had a difficult time finding monetary support for its dedication ceremony. The Oregon Coast Association promised $200 to cover expenses, but the OSHC denied former Oregon Governor A.W. Norblad's request that it give $250 for the cause. In April, the commission wrote that it had "no legal authority" to expend funds for purposes of this kind, but it "fully supported" the enthusiasm for a dedicatory celebration.[11]

The OSHC dampened the spirits of some local organizers. Secretary Withrow seemed to think that the commission had its priorities wrong since he believed the state of Oregon had a vested interest in seeing that the celebration of the opening of the bridge and highway was a success. The completion of both projects might breathe new life into once isolated fishing villages that were experiencing severe economic problems brought on by the Great Depression.[12]

On behalf of the celebration committee, Oregon's U.S. Senator Frederick Steiwer wrote Herbert Hoover about participating in the ceremony. He asked the President if he would operate a historic gold telegraph to send a transcontinental message that would unlock a barricade erected across the bridge. Thereafter, the committee planned a short program with prominent state and regional officials, followed by a luncheon. In addition, there would be motorboat races, band concerts, and a "jutney" dance. Local citizens prepared to accommodate the expected five to seven thousand visitors.[13]

As the twenty-eighth approached, donations poured in from private citizens for the celebration. The local committee's financial worries vanished. Dedication day went on without any problems, except, according to the Curry County Reporter, President Hoover did not actuate the telegraph key at the White House. Instead, because the President would be vacationing at Camp Rapidan, Virginia over the Memorial Day weekend, Vice President Charles Curtis took his place at the key and "signified to the world that the Rogue River bridge was a complete structure and open for travel." Many news accounts of the dedication ceremonies mentioned that Hoover and not Curtis keyed a message to Gold Beach. While Curtis travelled to the White House on 28 May, he arrived there at 3:45 p.m. E.S.T., one hour and fifteen minutes after the time that Hoover was to send the electrical impulse, 11:30 a.m., Pacific Time. A record of the President's activities for the day shows that he was at the White House's Executive Office Building until he left for Camp Rapidan shortly after five o'clock in the afternoon. It did not mention any ceremony with a telegraph key. At this point it is not known whether anyone in Washington, D.C., participated in the dedication of the Rogue River Bridge or of the Oregon Coast Highway.[14]

DESIGN AND DESCRIPTION

Conde B. McCullough, Bridge Engineer for the OSHD since 1919, designed the 1,898-foot bridge at the mouth of the Rogue river with aesthetic and practical considerations in mind. He hoped to create a multi-arched structure that blended well with the rolling hills of the coastal mountain range. He also sought to economize on the costs of construction by employing a European technique for decentering reinforced-concrete deck arches that had never been used before in the United States. He believed that the Freyssinet method for shortening ribbed arches would reduce the cost of construction by ten percent, because it would lead to a need of ten-percent less concrete and reinforcing bar.[15]

The Bridge at the Mouth of the Rogue River is a multi-arched span consisting of a set of nine 16-foot reinforced-concrete deck girder spans with semi-circular arched facia curtain walls on either end of a series of seven 230-foot reinforced-concrete ribbed deck arches. Deck width, curb-to-curb, is 27'. Out-to-out, it measures 34'. The approach viaducts rest on bents anchored to solid rock, as do the abutments, piers 1 and 8, at the extreme north and south ends of the main structure. Piers 2 through 7 are solid pedestals resting on piling.[16]

Footings for piers 2, 4, 5, and 7 consist of 180 logs, 15' in length, driven vertically. Bases measure 29'x38'. Concrete seals, 8' to 10' thick, cap the pile heads and serve as foundations for the piers. McCullough designed pedestals 3 and 6 as abutment piers to resist heavy thrust from adjacent arches. They rest on grids of 260 batter piles, driven half each direction along the longitudinal centerline of the span, at angles 20 degrees off the vertical center of the piers. Crews used hoists and derricks operating clamshell buckets to excavate piers. They drove the piling with a Vulcan steam hammer, using a five-ton weight, that delivered sixty blows per minute. By 1 December 1930 crews had poured concrete for all of the piers.[17]

Gold Beach, Oregon, in 1930, was eighty miles from the nearest railway line, so all cement and rebar was sent by boat to Port Orford, thirty miles north of the construction site. Then trucks brought it south to the mouth of the Rogue river. Lumber came from mills at Bandon, a coastal city sixty miles to the north. Crews obtained logs for pilings from local forests and concrete aggregates from the river itself. Carpenters built the form work in an open-air shop adjacent to the construction site. They also reduced the amount of hand work traditionally seen in their jobs by relying almost exclusively on portable electric saws. Likewise, rebar was sent to the site pre-cut to proper length. There, the Roy Saunders Company of Sacramento, California bent the steel.[18]

The concrete plant was on the north bank of the river. Workers mixed cement from cloth bags with local aggregate and water, elevated it by an 80-foot high wooden tower and distributed it through a wooden shoot to the forms. The tower was originally moved on skids on a platform constructed parallel to the falsework, but later extended to 104' and placed on railroad tracks. Concrete for piers, columns, and beams had a compressive strength of 2,500 psi. For the deck slabs it was rated at 3,000 psi, and for the arch ribs, 5,000 psi.[19]

Once falsework was in place, crews poured the arch ribs continuously, except for a section near each skewback, and at the crowns. McCullough feared that as the deck and spandrel columns were placed above the arches, they might cause the falsework to settle and create cantilever action in the ribs which would place extraordinary stresses in the ribs at their bases. This was a serious worry since the ribs were not as massive as usually seen on deck arch structures on which the traditional de-centering technique is employed. Crews closed the lower portions of the ribs when they completed the superstructure. McCullough left the crowns unfinished so that he could easily insert hydraulic jacks for the Freyssinet method of arch decentering.

In the early twentieth century, French bridge engineer Ernest Freyssinet perfected a method for decentering reinforced-concrete bridge arches. He had applied it to sites in his own country, as early as 1908, where traditional reinforced-concrete structures with relatively flat deck arches would experience much elastic shortening once their falsework was removed. He saw it as cost prohibitive to strengthen arch ribs by designing them with additional concrete and rebar. As an alternative, Freyssinet chose to leave open the arch ribs of his bridges at their crowns and introduce a system of hydraulic jacks to lengthen the ribs to an amount calculated to equal the shortening produced by dead load, shrinkage of concrete, and differential temperature changes in the concrete. Once jacked to position, ribs were keyed with high-strength concrete and reinforcing bars at the crowns are spliced. Theoretically, Freyssinet believed that they would shorten to the point that they had been initially. The ribs, then, would not experience the usual cracking and sagging that was common in reinforced-concrete arched bridges. They required less concrete and rebar and produced a reduction in costs for construction.[20]

McCullough employed the Freyssinet method at the structure at Gold Beach as part of an experiment in bridge design that the U.S. Bureau of Public Roads and the Oregon State Highway Commission conducted jointly to determine the technique's advantages and disadvantages. Moreover, they wished to fathom better the behavior of arch ribs after decentering and the restraint exercised by an articulated spandrel structure upon the distribution of rib stress. Finally they hoped to understand the degree to which form work prevented the ribs from moving after decentering and the effects of temperature changes and shrinkage in rib concrete from the time that it was poured.[21]

This was the first application of the French bridge engineer's technique in the United States. At Gold Beach, McCullough laid out the seven-arch span in the traditional manner for fixed arch construction. He estimated the residual shrinkage of concrete and computed the dead load of the structure itself. Yet, he also calculated the compensating or adjusting stresses that hydraulic jacks would introduce to the ribs and the structure as a whole.[22]

During construction, the OSHD ordered sixteen 275½-ton water-activated hydraulic jacks from the same Paris firm that Freyssinet had earlier purchased his, the Etablissements Morane Jeune. Each rib required four jacks, two extrados and two intrados at the crown. Thus, with sixteen jacks, McCullough could de-center two arches simultaneously. For each span he had the extradosal and intradosal jacks connected to separate systems with "Bourdon" pressure meters and hand activated plunger pumps. McCullough designed structural steel emplacements extending ten feet into the ribs from the arch crowns to transfer the thrust of the jacks into the ribs. In addition he intentionally left a 3-inch gap between the ends of the rebar on either side of the crown and left the steel exposed one foot back on both sides. This facilitated easy installation of the jacks and made space for welders to key the arch ribs once the decentering had taken place.[23]

McCullough only had enough jacks to de-center two arches simultaneously. After compressing and keying arches for spans 1 and 2, he needed to insert a temporary key at the crown of each rib in arch five. The center three spans (nos. 3, 4, and 5) were spaced between two piers, nos. 3 and 6 that were reinforced with batter piling to resist horizontal thrust. Prior to jacking arches 3 and 4, McCullough placed temporary keys in the ribs of arch 5 to transfer the thrust created in arches 3 and 4 to pier no. 6. Finally, after jacking and final keying had taken place on all the arches, he completed the concreting of the crowns and covered the east and west elevations with ornamental cartouches to hide any irregularities in the texture of concrete that the public might see.

McCullough wrote the Morane Company of Paris, in June 1930, for plans for its 250 metric-ton hydraulic jacks and necessary valves and pumps (250 metric tons = 275.6 English tons). It replied in late July with drawings for a forged steel model that had been used on the arch crowns of the La Tournelle bridge in Paris in 1928. A second model, differing from the first in that its piston was threaded, prevented the jack from accidentally compressing if it lost hydraulic pressure. The Limousin Company of Paris had used this type in constructing the Bridge over the Elorn River at Plougatel, France earlier in the year.[24]

Shortly, McCullough and his design team decided to use a threaded version of the jack on the Rogue river bridge and placed an order for the sixteen on them, and necessary pumps and gages, in late September. The order that McCullough placed with the Morane Company arrived by steamer in Washington, D.C. in January 1931. The Bureau of Public Roads' Division of Tests calibrated the pumps and gages and then shipped the equipment to Salem. The invoice from Paris totaled $5,950. By adding charges for customs duties, brokers' fees, and freight, the jacks, pumps, and gauges cost about $8,200. The equipment arrived in Salem by February 1. The decentering process began in mid-September.[25]

McCullough worried that when the jacks exerted thrust upon the ribs they might have an adverse effect on the whole superstructure, and that fixed spandrel columns and deck would restrain the ribs and prevent the articulation that he wished to achieve. Construction operations made it impossible to de-center the arch ribs without the spandrel structure, including the deck. Because of this, he used a system of articulation and expansion joints to make it more forgiving and flexible. Columns above the piers and near the skewbacks were fixed at their bases because they were comparatively long and flexible, offering little restraint. McCullough articulated the next two columns at their bases by using socket hinges. At the top of the spandrels above the piers he inserted permanent sliding bronze expansion joints to separate deck stringers from floor beams. He designed temporary articulation points at the tops of columns above the ribs to eliminate any bending stresses that the stiff, continuous floor system might introduce into the arch rings. Once the ribs were decentered and keyed, these points were filled with grout and made rigid.[26]

McCullough also used temporary roller bearings at the top of each spandrel one away from spandrels directly on either side of the crowns to give the arches more flexibility during decentering, after which they were made solid. To assure additional movement in the superstructure he cut an expansion joint and installed roller-bearing shoes. On the south side, he put in place one set of roller bearings on each rib and had a "dummy" expansion joint cut through only the roadway. This gave the deck additional flexibility during decentering and prevented unwanted cracks from developing on it. Once the ribs were keyed, he had these dummy joints filled with asphaltic felt. McCullough's rationale for the seemingly complicated system of articulation points was that they "served to remove all superstructure restraint during the operation of decentering and to render all column loads truly vertical."[27]

McCullough installed telemeters and other apparati at many points in structure to record the distribution of stress created by the jacks. He did this to learn more about how stress was transmitted from ribs to piers in reinforced-concrete deck arch bridges. He acknowledged that it was nearly impossible to determine exactly the distribution of rib stresses in arches constructed in the traditional manner. This uncertainty, he believed, made it imperative that engineers use a process in decentering that guaranteed, as closely as possible, shortening that closely approximated mathematical calculations.[28]

McCullough's findings proved Freyssinet's theories about the method. It succeeded in minimizing shortening and greatly reducing stress at skewbacks. As a consequence, the relatively untried technique greatly reduced the amount of reinforcing bar and concrete needed in construction. Nevertheless, McCullough's belief that the method produced a reduction in total construction costs remains to be seen. Critics have contended that the extra amount of skilled labor needed in the Freyssinet method of arch decentering equals or even outweighs any savings in materials. In addition, if the U.S. Bureau of Public Roads had not provided funds to test the hypothesis, McCullough could not have attempted it.[29]

The Freyssinet method permitted the use of slender, even delicate, arch ribs that combined well with McCullough's use of a mixture of classical designs and "Art Deco" embellishments of the Moderne school. He attempted to intertwine the old with the new. In the progression of his bridge designs from the early 1920s to the mid 1930s, the structure at the mouth of the Rogue river serves as a watershed. While the deck arch form that he used is much like the open-spandrel ribbed spans that he designed for the Rogue River Bridge at Rock Point (HAER No. OR-29) in 1920, and especially the seven arch Winchester Bridge over the North Umpqua River (HAER No. OR-33) in 1924, it melds the classical with the emerging popular style of the time. Later structures at North Bend, Reedsport, Florence, Waldport and Newport show an explosion of Art Deco treatment of balustrades, entrance pylons and piers.

At Gold Beach, McCullough design appears timid in comparison to his designs for the five coastal bridges that the OSHD and the federal Public Works Administration built in the mid-1930s. Elaborate, classical, dual elbow-like brackets support the sidewalks and railings. Entry pylons are ornamental extensions of the first set of piers at each end of the structure. Their pedestrian passages have simple Palladian windows in east and west walls and semi-circular arched doorways adorned with stylized Egyptian sunbursts. Rather small two-tiered obelisks cap the passageways and form the tops of the pylons.[30]

REPAIR AND MAINTENANCE

The Bridge at the Mouth of the Rogue River passed its initial inspection in 1932 in perfect order, save for two bothersome problems. Vehicles crossing the bridge had flung up gravel from the highway approaches that caused nasty rock chips to entrance railings. Poorly designed weep holes on the roadway were prone to clogging. Final costs for construction totaled $592,725.56, less than estimates from the late 1920s that projected spending to exceed $600,000. The quantities of principal components used in construction included the excavation of 10,174 cubic yards of fill, 27,016 linear feet of piling, 15,591 cubic yards of concrete, 1,764,981 lbs. of rebar, and 114,109 lbs. of structural steel.[31]

Maintenance costs from the end of construction through 1948 amounted to $2,368.23. These included expenses for periodic soundings at piers to look for scouring, repairs to the lighting systems of the pedestrian passages in 1935 and 1938, and replace non-functioning bronze expansion plates at pier no. 6, in 1941, because they were not functioning. Weep holes continued to require repair and generated complaints from citizens because water pooling on the roadway caused them to lose control of their automobiles. Yet, their location in the curbs made it difficult to solve the problem because the proximity of deck beams prevented maintenance crews from drilling vertically through the deck to increase drainage.[32]

In April 1955 the Bureau of Public Roads approved the Oregon State Highway Commission's plans to widen the structure's north approach. Originally, it curved to the east. The new alignment, completed that year, fanned out to accommodate vehicles from two directions. The Highway Department replicated the balustrades that it removed during the widening of the approach so that to the untrained eye, the structure appeared completely original.[33]

Underwater pier inspection revealed in the mid-1970s that marine borer had completely destroyed nearly a dozen piles supporting pier 2. In 1974, maintenance crews repaired three on the north side and later sealed three on the south side with epoxy. Inspectors suggested that design and construction error had caused the destruction. Driving and construction tolerances in the early 1930s led to much of the piling receiving little concrete covering. In addition, unsatisfactory cleaning of forms and underwater pouring techniques caused the concrete seals to be of an inferior quality. In the 1970s and early 1980s crews riprapped piers 3, 4, and 6 to prevent additional scouring.[34]

Visual inspection of the bridge in December 1982 revealed spalled concrete on one of the spandrel columns south of pier 6. Inspectors reported that they had previously encountered this condition and found that replacing defective bronze expansion joints with neoprene pads curtailed the problem.[35]

In the mid-1980s inspectors noted that pier 7 experienced vertical movement of as much as .02 feet under live load. One possible reason for this was that piling under this pier had deteriorated due to marine borer infestations. In addition, core samples revealed that the sand and gravel substrata on which the piling rests was more compressible than originally thought. In any event, the vertical movement of pier 7 caused failure in the short stiff columns of spans 6 and 7 as the tops and bottoms moved in opposite horizontal directions.

Today, the bridge appears in satisfactory condition with only minor spalling of curtain walls. The OSHC plans to widen the south approach within the next few years.[36]

ENDNOTES

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6. Betty Van Leer, "Spanning the Mighty Rogue--How the Bridge was Built," Supplement to the Curry County Reporter (Gold Beach, Oregon), 26 May 1982, pp.7-9.

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8. Ibid., p.18.

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10. Ibid., pp.18-19; "Rogue Bridge Name Honors Former Governor," Supplement to the Curry County Reporter (Gold Beach, Oregon), 26 May 1982, p.20; Oregon State Legislature, House Concurrent Resolution No. 1, 24 February 1931, copy located in RG-H4, 76A-90/3, Folder 8-4, Oregon State Archives; OSHC to Mrs. H.J. Edwards, Coos Bay Chapter of the Daughters of the American Revolution, 18 January 1932, RG-H4, 76A-90/3, Folder 8-4, Oregon State Archives.

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13. Thomas T. Thalken, Director, Herbert Hoover Presidential Library, Letter to Ray A. Allen, 12 September 1980, located in the personal Collection of Mr. Allen, Portland, Oregon; Withrow to McCullough, 6 May 1932, RG-H4, 76A-90/3, Folder 8-4, Oregon State Archives; "Spanning Over the Mighty Rogue," p.19; Withrow to McCullough, 6 May 1932.

14. Curry County Reporter (Gold Beach, Oregon), 2 June 1932; "The President's Day at the Executive Offices, 28 May 1932," U.S. Daily (Washington, D.C.), 31 May 1932.

15. Albin L. Gemeny and C.B. McCullough, Application of Freyssinet Method of Concrete Arch Construction to the Rogue River Bridge in Oregon. A Cooperative Research Project by the U.S. Bureau of Public Roads and the Oregon State Highway Commission (Salem: Oregon State Highway Commission, 1933), p.2.

16. ODOT, Bridge Section, "Bridge Plans: Bridge at the Mouth of the Rogue River (No. 1172)," Drawing No. 3888.

17. Ibid., Drawing No. 3889; W.A. Scott, "Rogue River Bridge at Gold Beach, Oregon," Western Construction News and Highways Builder, 25 May 1932, p.281.

18. G.S. Paxson and Marshall Dresser, "Concrete Arch Ribs of the Rogue River Bridge Decentered by Built-In Jacks," Construction Methods, April 1933, p.37.

19. Ibid, pp.37-39.

20. Gemeny and McCullough, pp.4-5; Conde B. McCullough and Albin L. Gemeny, "Designing the First Freyssinet Arch to Be Built in the United States," Engineering News-Record 107 (26 November 1931), p.841.

21. Gemeny and McCullough, pp.7-8; See Gemeny and McCullough in its entirety for a complete discussion of the Freyssinet method and its application at the Bridge at the Mouth of the Rogue River.

22. McCullough and Gemeny, pp.841-42.

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25. McCullough to Gemeny, 9 August 1930, "Bridge at the Mouth of the Rogue River (No. 1172)," Microfilmed Records, ODOT Bridge Section; Telegram, Morane Hydro to McCullough, 26 September 1930; Consumption Entry, United States Customs Service, District No. 13, Invoice No. 32176, 13 January 1931; Receipt, L.P. Seibold, Inc., Washington, D.C., 22 January 1931; Freight Bill No. 5378, Baltimore and Ohio Railroad Co., 20 January 1931; McCullough to E.S. Thayer, OSHC, 29 August 1931.

26. Gemeny and McCullough, pp.8-9; McCullough and Gemeny, pp.844-45.

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35. Walter J. Hart, Bridge Engineer, Letter to Jim Gix, Region III Engineer, 26 January 1983, Bridge at the Mouth of the Rogue River (No. 1172), ODOT Bridge Section Maintenance Files.

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ADDENDUM TO
BRIDGE AT MOUTH OF ROGUE RIVER
(Isaac Lee Patterson Memorial Bridge)
Spanning Rogue River at the Oregon Coast Highway
Gold Beach
Curry County
Oregon

HAER No. OR-38

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